

Reprinted from

PROCEEDINGS OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON

Vol. 70, No. 4, December 1968

pp. 376-382

Made in the United States of America

**A REVISED INTERPRETATION OF THE PROCTIGER OF MALE
URANOTAENIA WITH A RELATED NOTE ON HODGESIA**

(DIPTERA: CULICIDAE)

E. L. PEYTON and R. H. HOCHMAN

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE DEC 1968		2. REPORT TYPE		3. DATES COVERED 00-00-1968 to 00-00-1968	
4. TITLE AND SUBTITLE A Revised Interpretation of the Proctiger of Male Uranotaenia with a Related Note on Hodgesia				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Smithsonian Institution,Southeast Asia Mosquito Project,Washington,DC,20560				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 8	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

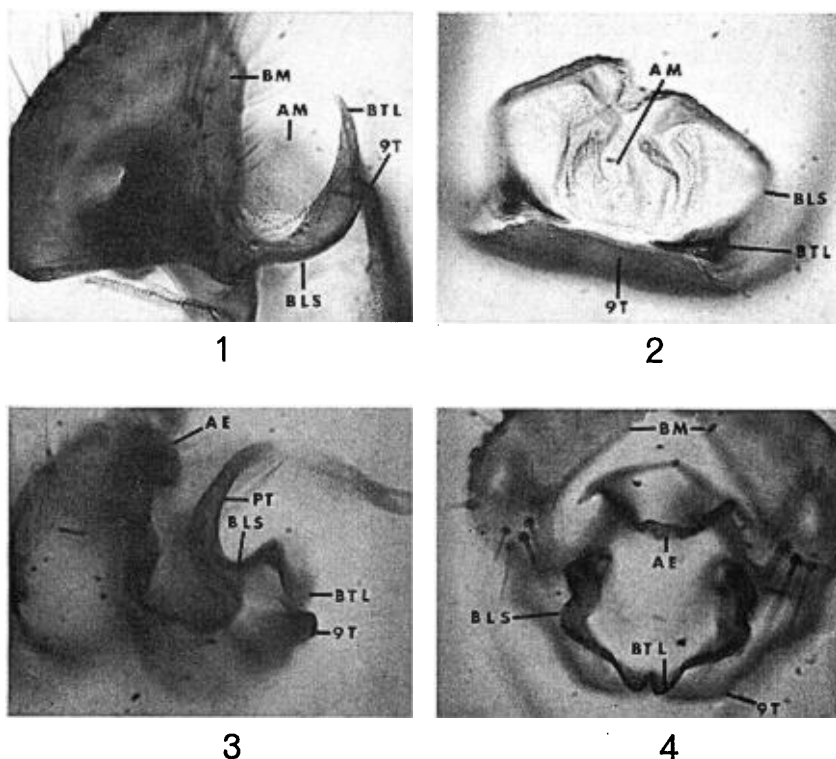
**A REVISED INTERPRETATION OF THE PROCTIGER OF MALE
URANOTAENIA WITH A RELATED NOTE ON HODGESIA**
(DIPTERA: CULICIDAE)^{1,2}

E. L. PEYTON and R. H. HOCHMAN, *Southeast Asia Mosquito Project,
Smithsonian Institution, Washington, D.C. 20560*

Although the structure of the male terminalia has long been recognized as an important criterion in the classification of mosquitoes, their structure in the genus *Uranotaenia* Lynch Arribálzaga remains little studied and incompletely understood. The forms of the proctiger and the ninth tergite have received contradictory and confused treatment. Edwards (1920) proposed the term "lobes of the ninth tergite" for the more or less distinct prominences at the apical margin of the tergite. He indicated their various development in different genera, mentioning that in at least one species of *Uranotaenia* they were without bristles. Subsequent authors recognized Edwards' lobes in other species of *Uranotaenia* (Dyar and Shannon, 1925; Matheson, 1944; King and Hoogstraal, 1946; Pratt, 1946; La Casse and Yamaguti, 1950; Galindo, Blanton and Peyton, 1954; Peters, 1963a, 1963b, and 1964). Lane (1943 and 1953) used the term "external bars" for these structures. Belkin (1953 and 1962) described the lobes of the ninth tergite with "ventrolateral sclerotization" in South Pacific *Uranotaenia*. The proctiger was regarded as almost completely or completely membranous. Freeborn (1924), however, studying terminalia of many culicid genera, concluded that in *Uranotaenia* the proctiger bore on its dorsal face a pair of "broad, well chitinized sclerites recurved over the summit," to which he applied Crampton's term "epiprocts." He seems to have drawn this generalization from an examination of one species, *U. geometrica* Theobald, which he figured with a dorsal lobar plate of the proctiger, discontinuous with the ninth tergite and with no basolateral extension. Carpenter, Middlekauff, and Chamberlain (1946), while following the standard usage of Edwards' terminology, parenthetically registered doubt that these were true lobes of the ninth tergite in *Uranotaenia* and suggested that the so-called "lobes" were productions of the tenth tergite or tenth sternite (proctiger). Yamaguti and La Casse (1951) and Carpenter and La Casse (1955) reiterated this interpretation. The most thorough examination of *Uranotaenia* terminalia was made by Dampf (1943) in his study of *Uranotaenia syntheta* Dyar and Shannon. His excellent, detailed figures of the terminal structures in lateral, posterior, and tergal views show basolateral sclerotization of

¹ This work was supported by Research Contract No. DA-49-193-MD-2672 from the U.S. Army Medical Research and Development Command, Office of the Surgeon General.

² Immediate publication secured by full payment of page charges—Editor.



Figs. 1 and 2, *Uranotaenia geometrica* Theobald, ♂ terminalia: 1, lateral view; 2, anterior view. Figs. 3 and 4, *Hodgesia malayi* Leicester, ♂ terminalia: 3, lateral view; 4, anterior view. Abbreviations: AE, aedeagus; AM, anal membrane; BLS, basolateral sclerotization of proctiger; BM, basimere; BTL, basotergal lobe of proctiger; PT, paraproct; 9T, ninth tergite.

the proctiger articulating with a pair of lobes which are fused with the apical margin of the ninth tergite. These lobes he regards as tongue-shaped "protuberancias" of the ninth tergite. Like Edwards, he asserts that corresponding lobes occur in many genera ("tan frecuentes en muchos culicidos").

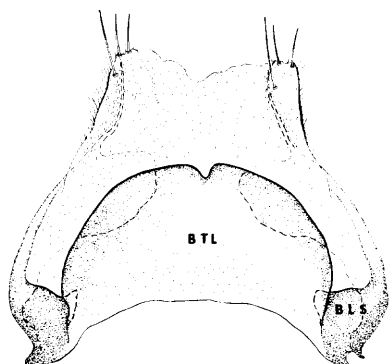
In the course of studies of the genus *Uranotaenia* in Southeast Asia, we have determined that the "lobes of the ninth tergite" of the above-mentioned authors are, in *Uranotaenia*, wholly continuous with the basolateral sclerotization of the proctiger, and thus they are on the contrary, lobes of the proctiger (figs. 1, 2). Belkin and Page in work in progress on Jamaican *Uranotaenia* have independently arrived at this same conclusion and have proposed the term "basotergal lobes of the proctiger" for these structures (personal communication with Dr. Belkin).

This paper presents techniques that allow careful study of terminalia, indicates the range of development of the proctiger lobes in *Uranotaenia*, and considers their possible phylogenetic significance. It is hoped others will be stimulated to investigate the proctiger development of additional species of *Uranotaenia* and allied genera. Further study of the variation in the form of the basotergal lobes of the proctiger with speciation will, we feel certain, increase our understanding of the phylogeny within the genus and with other genera.

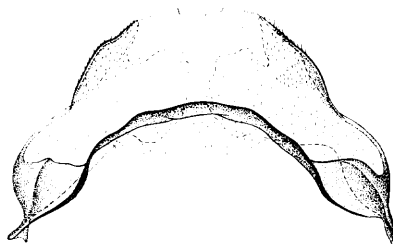
The experiences gained from the present study indicate the need to emphasize the absolute necessity of dissecting the terminalia of *Uranotaenia*, for an accurate interpretation of all the structures. Whole mounts are totally inadequate and should be made only after an adequate series of dissections has been prepared. In view of the obvious value, we present a detailed discussion of techniques we have found satisfactory for the preparation and dissection of the terminalia of *Uranotaenia*.

Our method of preparation of terminalia is modified from that of Galindo, Blanton, and Peyton (1954). After the terminal segments of several specimens are clipped they are placed in small 5 cc test tubes containing 10% KOH. The tubes are then placed in a beaker of boiling water for approximately 20 minutes. The parts are transferred to a weak solution of acetic acid to neutralize the alkali. They are then dehydrated in alcohol and transferred to a staining solution of 1% acid fuchsen in 70% alcohol and allowed to remain for approximately 20 minutes. The staining dish should be as small as possible for the terminalia of the smaller species are extremely difficult to find after staining. The dish should be covered to prevent rapid evaporation of the alcohol. The terminalia are transferred from the stain to a drop of liquid phenol on a concave slide for dissection. If clearing of the stain in the phenol appears too rapid, a small drop of copal-phenol can be added to arrest the clearing. The individually dissected parts are positioned in minute drops of copal-phenol on a clean slide and then placed in a drying oven for a minimum of four days in order to drive off the phenol and harden the drops. If larger amounts of copal-phenol are used the required drying period must be increased, for any remaining phenol will crystalize as the slide ages and degrade the quality of the mount. After the copal-phenol is thoroughly dried, small bits of cover-slip glass are placed around the specimen and then covered with a drop of thin balsam and a small cover slip. If prepared in this manner the prepositioned parts will not move and the bits of glass will prevent crushing from the gradual settling of the cover slip. There are other satisfactory preparation methods, but all share two essential cautions. Due to the extremely small size of many *Uranotaenia* species and the generally weakly sclerotized structures of the terminalia, it is absolutely necessary to use a moderate stain after maceration in KOH.

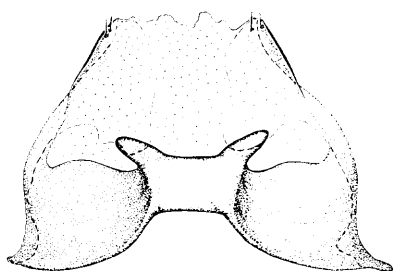
FIG. 5



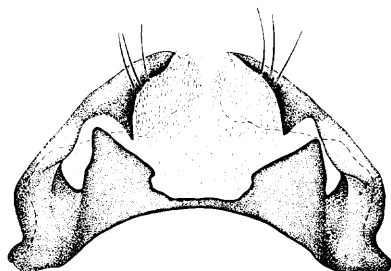
U. breviostris Edwards .



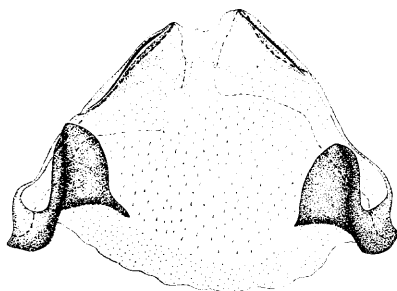
U. obscura Edwards .



U. rossi Delfinado .



U. nivipleura Leicester .



U. subnormalis Martini .



U. lateralis Ludlow .

Atloscuns

Fig. 5, Tergal views of proctiger of *Uranotaenia* species. Abbreviations: BLS, basolateral sclerotization of proctiger; BTL, basotergal lobe of proctiger.

Dissections should never be made in the staining solution or other dark media, for the structures and points of attachment can not be seen clearly under an ordinary dissecting microscope. Dissecting in the staining solution as suggested by Galindo, Blanton, and Peyton (1954), is the primary reason these authors failed to correctly interpret the lobes of the ninth tergite and the proctiger in the American *Uranotaenia*. It is strongly suggested that prior to mounting or dissecting any mosquito terminalia, a thorough examination be made from all angles in a clear non-volatile medium such as phenol, glycerin, or clove oil. Only in this manner can all the structures and points of attachment be correctly identified and the structures removed in a logical sequence without damage. With terminalia of *Uranotaenia* an examination should also be made to assure that the anal lobes are not everted. This condition has been observed in the majority of reared material examined. As the presence and position of apical bristles and the overall configuration of the proctiger are of diagnostic value, an attempt to reshape the structure should be made. We have usually found it sufficient to insert a dissecting pin through the anterior orifice of the proctiger and gently push the lobes outward until they are fully distended.

Our analysis of the development of the proctiger in *Uranotaenia* is based upon an examination of 30 species (26 Southeast Asian, three American, and one South Pacific). Two American species, *U. geometrica* and *U. syntheta*, were also examined since they are the only two species whose terminal structures have been treated in some detail by previous authors (Freeborn, 1924; Dampf, 1943). We find in *geometrica* that those dorsal structures, identified by Freeborn as epiprocts, are extensions of the basolateral sclerotization, slightly recurved, but well above the dorsal face of the proctiger—that is, they are the basotergal lobes (figs. 1, 2). In *syntheta* the suture between the “protuberancias” and the basolateral sclerotization shown by Dampf in his posterior view is an interpretation not supported by our specimens. Furthermore, his lateral view of the basolateral sclerotization shows no such suture.

Essentially two types of development are seen in the basotergal sclerotization. In type I the sclerotization takes the form of a single broad median lobe, with or without a shallow or deep median apical emargination (fig. 5: *obscura* Edwards, *nivipleura* Leicester, *brevirostris* Edwards, *rossi* Delfinado). In the extreme form of this type (fig. 5: *nivipleura*) the median emargination is quite deep and the tergal sclerotization gives the appearance of type II. However, this condition of type I can be distinguished from type II development by the presence of a completely sclerotized dorsal bridge connecting the differentiated corners. This type seems to characterize Group C of Edwards (1941). In type II the basolateral sclerotization terminates in more or less well defined lobes which have an incompletely sclero-

tized or wholly membranous dorsal bridge. The lobes may be finger-like and well separated (fig. 5: *subnormalis* Martini) or extremely shallow and often closely approximated (fig. 5: *lateralis* Ludlow). This type seems to characterize Edwards' Groups A and B.

We have made a limited investigation of the development of the basolateral sclerotization in other genera. To our knowledge it is only in *Uranotaenia* and *Hodgesia* Theobald that the basolateral sclerotization assumes its peculiar tergal lobar modification. We have studied in detail two species of *Hodgesia*, *malayi* Leicester (figs. 3, 4) and *bailyi* Barraud. In *Culex* (*Melanoconion*) Theobald, the basolateral sclerotization is also highly modified but it is reasonably clear that the modification does not adapt it to the same function, even though the precise nature of their function may not be understood.

The strong development of ninth tergal lobes as seen in most other genera is conspicuously absent in *Uranotaenia* and *Hodgesia*. It is likely that the basolateral lobes in these genera have evolved to assume the function of the ninth tergal lobes.

Edwards (1932) erected the tribe Uranotaeniini to include *Uranotaenia*, *Hodgesia*, and *Zeugomyia* Leicester. Belkin (1962) placed *Uranotaenia* and *Hodgesia* in separate monotypic tribes, indicating that the two genera were unrelated and without close relatives. It is beyond the scope of this paper to make tribal classifications; however, the unique specialization of the proctiger and the absence of developed ninth tergal lobes in both genera appear to suggest a closer affinity than hitherto understood.

ACKNOWLEDGMENTS

We are indebted to Dr. Alan Stone of the U.S. Department of Agriculture and to Dr. Botha de Meillon, Project Leader, Southeast Asia Mosquito Project, for helpful discussions, encouragement, and assistance during the course of the work and for examining and commenting on the manuscript. We also had the privilege of discussing the work with Dr. J. N. Belkin, who kindly made his unpublished contribution on the subject available to us. Our thanks are due to Lt. Col. Bruce F. Eldridge for specimens of *U. geometrica* from his collection.

REFERENCES

- Belkin, J. N.** 1953. Mosquitoes of the genus *Uranotaenia* in the Solomon Islands (Diptera: Culicidae). *Pacif. Sci.* 7:312-391.
- . 1962. The mosquitoes of the South Pacific (Diptera, Culicidae). Vol. 1. University of California Press, Berkeley and Los Angeles. 608 pp.
- Carpenter, S. J., W. W. Middlekauff, and R. W. Chamberlain.** 1946. The mosquitoes of the southern United States east of Oklahoma and Texas. *Amer. Midl. Nat. Monogr.* 3, 292 pp.
- and **W. J. La Casse.** 1955. Mosquitoes of North America (north of Mexico). University of California Press, Berkeley and Los Angeles. vi + 360 pp.
- Dampf, A.** 1943. Distribucion y ciclo anual de *Uranotaenia syntheta* Dyar &

- Shannon en Mexico y descripcion del hipopigio masculino (Insecta, Diptera). Rev. Soc. Mex. Hist. Nat. 4:147-169.
- Dyar, H. G. and R. C. Shannon.** 1925. The types of Philippine mosquitoes described by Ludlow and other notes on the fauna. (Diptera, Culicidae). Insec. Inscit. Menst. 13:66-89.
- Edwards, F. W.** 1920. The nomenclature of the parts of the male hypopygium of Diptera Nematocera, with special reference to mosquitoes. Ann. Trop. Med. Parasit. 14:23-40.
- . 1932. Genera Insectorum. Diptera. Fam. Culicidae. Fascicle 194. Belgium. 258 pp.
- . 1941. Mosquitoes of the Ethiopian Region. III. Culicine adults and pupae. British Museum (Natural History), London. 499 pp.
- Freeborn, S. B.** 1924. The terminal abdominal structures of male mosquitoes. Amer. J. Hyg. 4:188-212.
- Galindo, P., F. S. Blanton, and E. L. Peyton.** 1954. A revision of the *Uranotaenia* of Panama with notes on other American species of the genus. Ann. Ent. Soc. Amer. 47:107-177.
- King, W. V. and H. Hoogstraal.** 1946(1947). New species of New Guinea *Uranotaenia* of the *tibialis* group (Diptera: Culicidae). Ann. Ent. Soc. Amer. 39:585-596.
- La Casse, W. J. and S. Yamaguti.** 1950. Mosquito fauna of Japan and Korea. Off. Surg., 8th U.S. Army, Kyoto, Honshu. 268 pp.
- Lane, J.** 1943. Sobre o gênero *Uranotaenia* (Diptera, Culicidae, Culicini). Rev. Ent., Rio de J. 14:137-161.
- . 1953. Neotropical Culicidae. São Paulo, Brazil. 1112 pp.
- Matheson, R.** 1944. Handbook of the mosquitoes of North America. 2nd ed. Ithaca, N.Y. 314 pp.
- Peters, W.** 1963a. Mosquitoes of New Guinea (Diptera: Culicidae). Part VII. A new species complex of *Uranotaenia* Lynch Arribálzaga, 1891. Proc. R. Ent. Soc. Lond. (B) 32:135-144.
- . 1963b. Mosquitoes of New Guinea (Diptera: Culicidae). Part VIII. New species of the genus *Uranotaenia* Lynch Arribálzaga, 1891. Proc. R. Ent. Soc. Lond. (B) 32:203-209.
- . 1964. Mosquitoes of New Guinea (Diptera: Culicidae). Part IX. Further new species of *Uranotaenia* Lynch Arribálzaga and notes on the genus. Proc. R. Ent. Soc. Lond. (B) 33:19-29.
- Pratt, H. D.** 1946. The genus *Uranotaenia* Lynch Arribálzaga in Puerto Rico. Ann. Ent. Soc. Amer. 39:576-584.
- Yamaguti, S. and W. J. La Casse.** 1951. Mosquito fauna of North America. Part II. Genera *Megarhinus*, *Wyeomyia*, *Uranotaenia*, and *Culiseta*. Off. Surg., Hq., Logistical Command, APO 343. 85 pp.